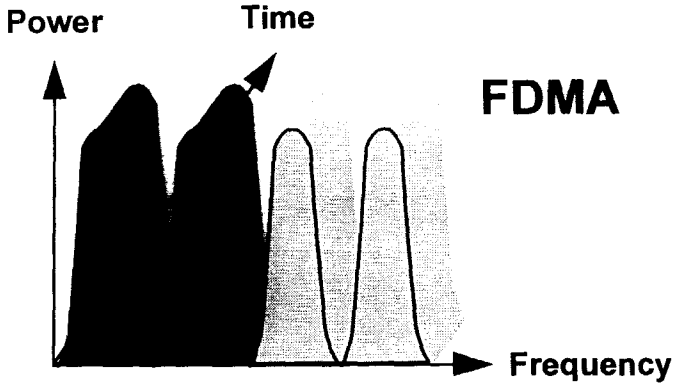
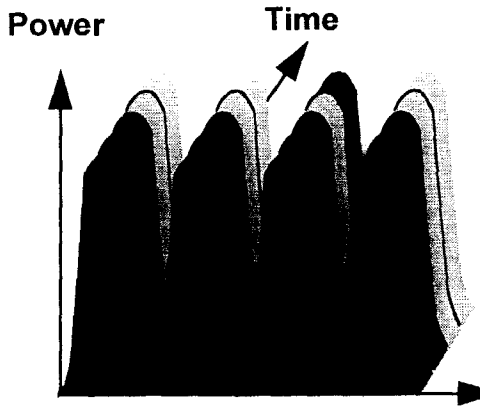
Code Division Multiple Access

- Airspan uses Direct Sequence Spread Spectrum Code Division Multiple Access (SS-CDMA) modulation on the Air-interface.
- CDMA is a technique that allows multiple communication channels to share the same designated segment of Radio spectrum.
- SS-CDMA uses specialised codes, shared by the Subscriber Terminal and the Central Terminal, to modulate the channels.
- Most of the initial work for the commercial application of CDMA has been for the North American Cellular/PCS market.
  - Airspan implements a version optimized for Wireless Fixed Access
- CDMA offers advantages over techniques such as FDMA and TDMA for Wireless Fixed Access.

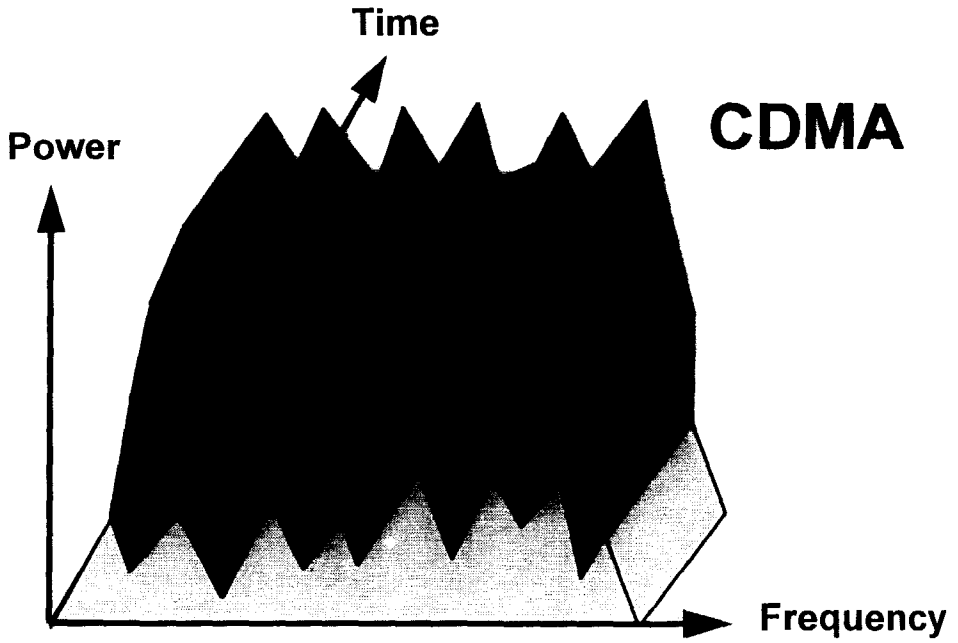
Multiple Access Structures



FDMA

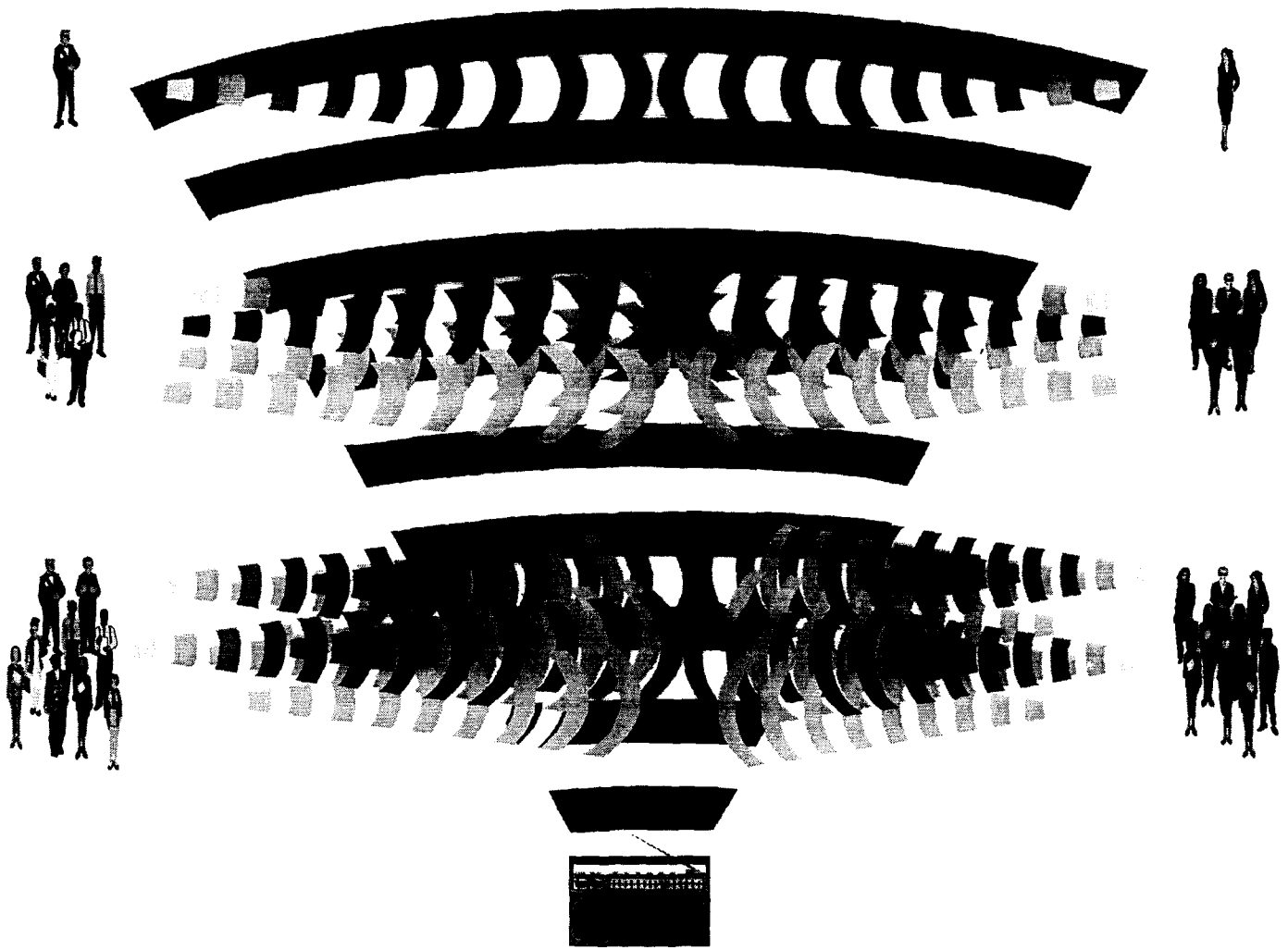


TDMA (FDM)



CDMA

CDMA Analogy



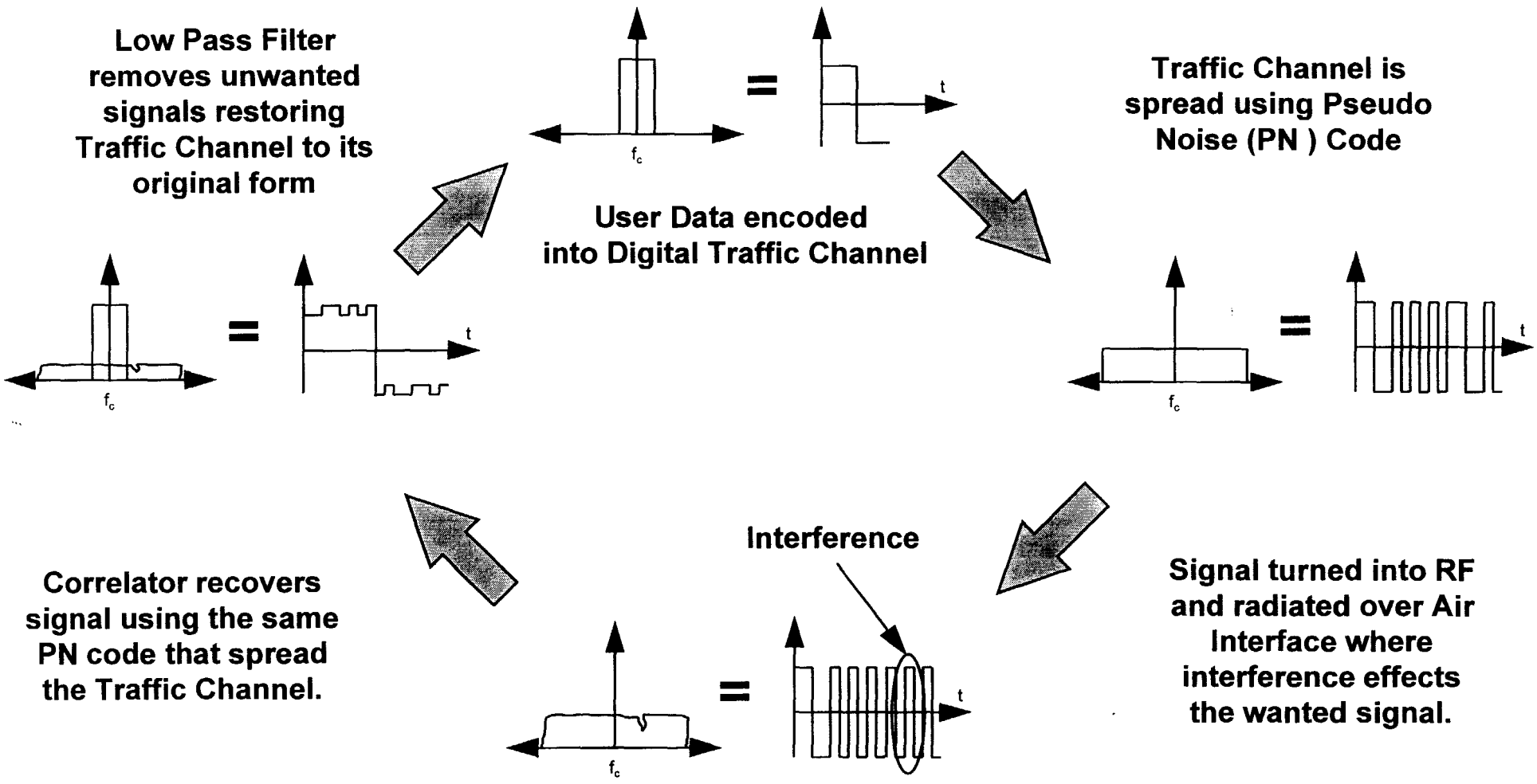
Background Noise

Single Conversation
(*Link*)
in one Language
(*One CDMA Code*)

A Few Simultaneous
Conversations
(*Links*)
Each in a Different Language
(*CDMA Code Sets*)

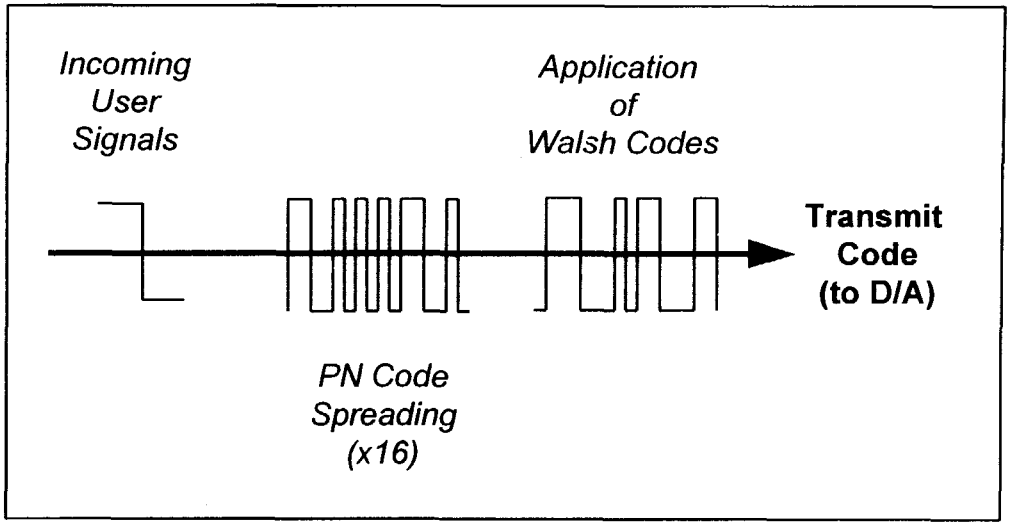
Many Simultaneous
Conversations
(*Links*)
Each in a Different
Language
(*CDMA Code Sets*)

Basic Spread Spectrum Principle

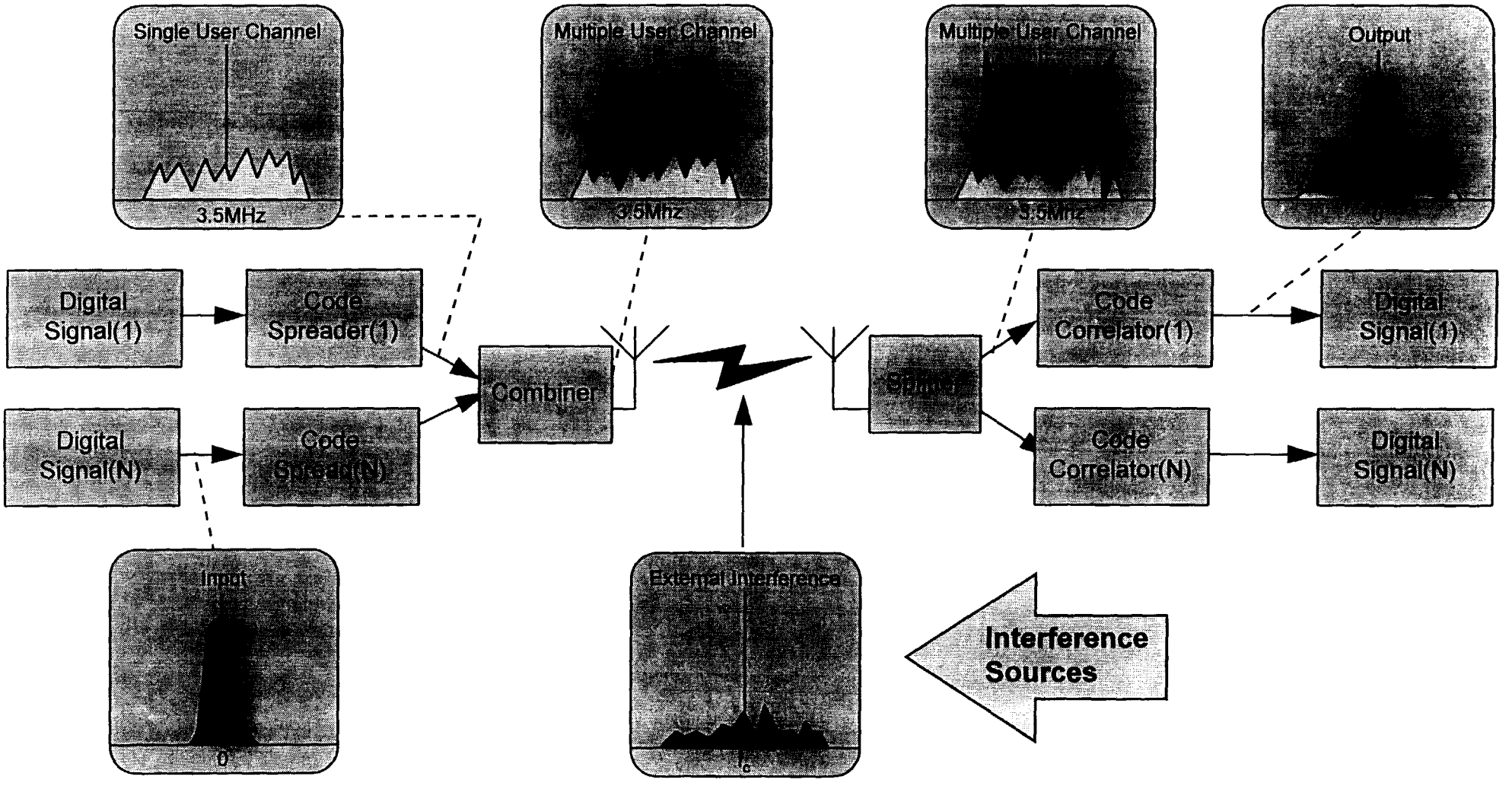


Orthogonal Coding

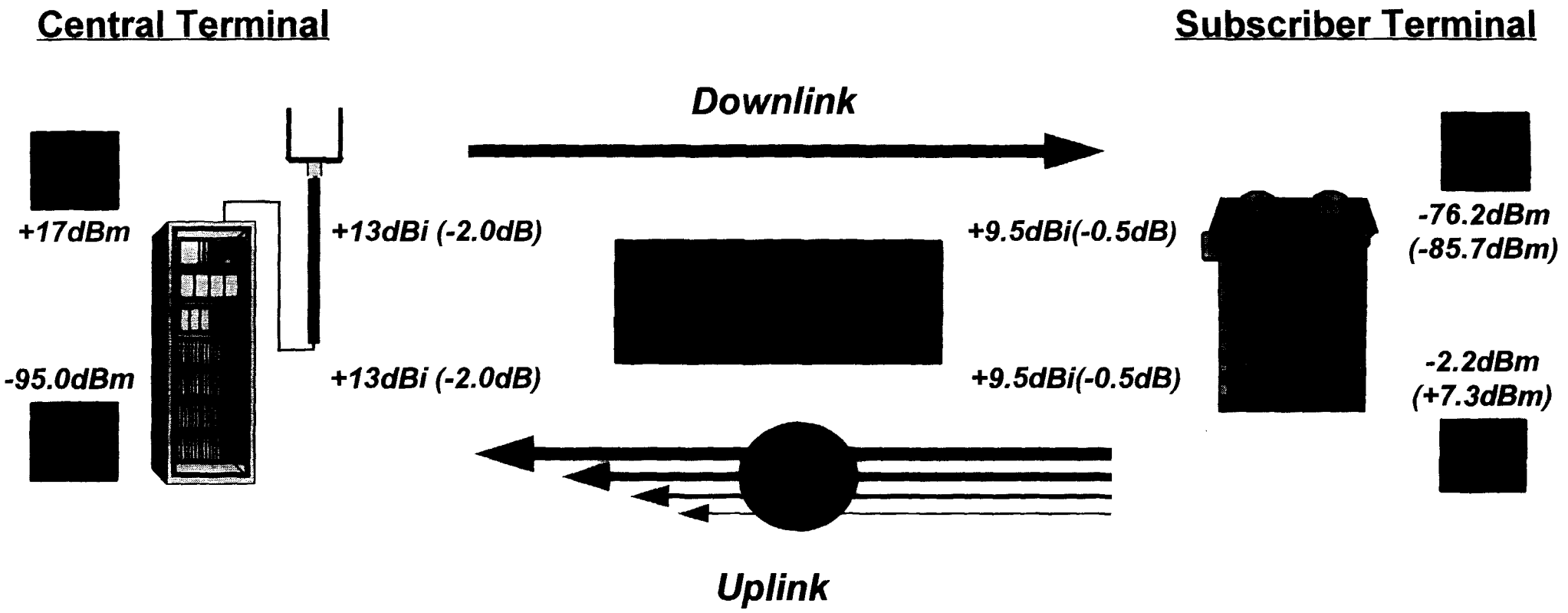
- Key to CDMA is application of Orthogonal Codes.
- Spreading of the User signal is performed using PN (Psuedo Random Noise) codes.
- Use of "*Orthogonal*" codes allows multiple traffic channels to be carried in same RF channels.
- Walsh codes are a mathematical set of sequences that have the function of "Orthonormality", or in other words, if any Walsh is multiplied by any other walsh code the results is null.



Multiple Access (Using CDMA)



Power Control and Link Budget



- Receiver Level set at -95dBm to provide link BER of better than 1 x 10^{-7}
- All Subscriber Terminals Power controlled by Central Terminal to maintain a constant received level at Central Terminal
- Transmit Power can be set lower by OA&M command to reduce cell size.
- Radio Path Budget System Release 2.0 is 130dB

CDMA Types

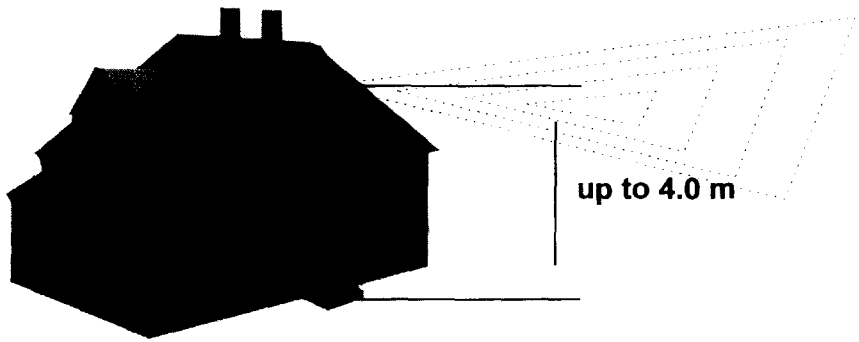
	IS95 (Qualcomm)	*N-CDMA (DSC's Airspan)*
Application	PCS	*Wireless Fixed Access*
RF Channels (B/W)	1.23 MHz	*3.5 MHz*
Channel Bit-Rate	9.6kbit/s	*To 144kbit/s*
Processing Gain	21dB	*12dB*
Processing Delay	>20ms	*<1ms*
FEC	1/3	*1/2*
Interleaving	Yes	*Optional*
Code Structure	Quasi Orthogonal	*Orthogonal*
Receiver Type	Rake	*Coherent*
Synchronized	No	*Yes*

More Than One Flavour of CDMA. Airspan CDMA is Optimised for WFA

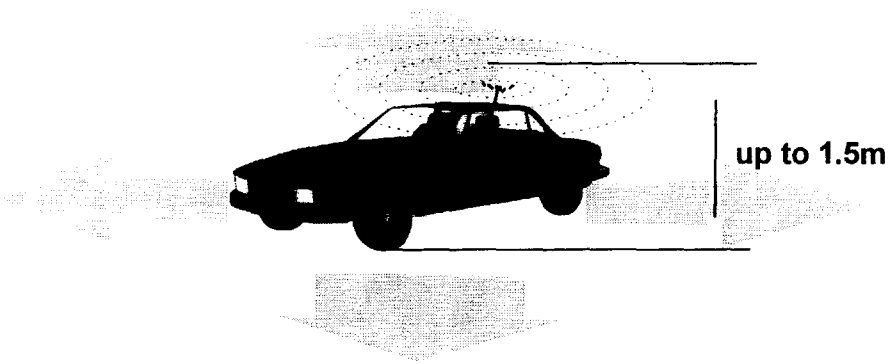
CDMA vs TDMA

- CDMA has inherent Processing Gain (from spreading)
  - Hence lower RF Power.
  - Ability to combat Access Noise
- Multi-path creates Access Noise, not Inter-Symbol Interference
- Creates less interference (unlike GSM and other TDMA systems)
- C/I advantage = 10 dB
  - Less susceptible to Interference
  - Allows a better Frequency Re-use (N=3 for Omni, not N=7 like TDMA)
- Lower Processing Delay (<1ms)
- Good BER without Adaptive Equalization

CDMA for Fixed Wireless Access



VS.



- **Fixed Location**
  - Reduced Multipath Environment
  - Subscribers are locked to a given cell -> Easier Teletraffic engineering (Planned GOS %).
- **Higher Antennas**
  - Protection against reflections from Local Clutter.
  - Reduced Path Loss.
- **Directional Antennas**
  - Reduced Interference with other Users / Cells.
- **No Handover**
  - System doesn't require mobility, hence no Handover Measurements, i.e. less complexity

Fixed and Mobile CDMA Types are Different